The Role of Diet in the Prevention and Management of Feline Diabetes

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BACKGROUND

Feline diets and their role in the prevention or treatment of diabetes have been the source of considerable discussion over the past 10 years, primarily because of the ongoing controversy as to whether the cat, an obligate carnivore, is best fed a diet more closely patterned after its ancestors, or whether diets created to meet their essential needs, but containing lower amounts of protein and higher amounts of carbohydrates, are a more economical, user friendly, and acceptable alternative.

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KEY POINTS

• To maximize the probability of remission, a low-carbohydrate diet should be introduced soon after diagnosis of diabetes when the cat is eating well.
• Because diabetic remission is an important goal, frequent monitoring (both of body weight and glycemic control) and access to controlled amounts of low-carbohydrate/high-protein food is the best strategy.
• Low-carbohydrate diets should be continued after remission to minimize postprandial glycemia, and the demand on beta cells to secrete insulin.
• For cats already on insulin therapy, when changing from a high-carbohydrate to a low-carbohydrate diet, the insulin dose initially should be reduced by 30% to 50% to avoid hypoglycemia.
• Combined with high protein to facilitate weight loss and maintenance of muscle mass, low-carbohydrate diets should be used in obese cats that have the potential to achieve remission.

KEYWORDS

• Feline • Diabetes mellitus • Diet • Protein • Obesity • Carbohydrates • Glucose

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The arguments for the alternative approach range from cats are living longer, to it is what consumers want, to there is no evidence that these diets are the cause of some of the most currently problematic feline diseases (such as obesity and diabetes). If one examines carefully the current state of feline health, however, we can clearly see we have traded one set of issues (a shortened life span due to fatal infectious diseases, parasites, dog attacks, and car accidents) for another set of equally big problems, with obesity topping the list and diabetes incidence increasing more than 100-fold. To be fair, it would be completely irrational to blame all of the ills of our indoor-living cats on their diets; however, to completely ignore diet as a risk factor when it is legitimate to do so, is also equally dangerous. So, the focus of the first part of this article is to review the currently available evidence and focus on how diet may play a role in lowering (or increasing) the risk of diabetes.

As in many feline diseases, dietary therapy is a very important aspect of successful management of the diabetic cat; however, dietary therapy of diabetes in the cat is not aimed solely at feeding a particular diet consistently, both in timing and energy. In contrast to dogs, because cats with diabetes most commonly have type 2 diabetes, the goal of therapy is to achieve diabetic remission, not just to manage the disease for the duration of the cat’s life. Diet is a very important part of this process to minimize the demand on beta cells to produce insulin. In addition, dietary therapy of diabetes must also help normalize body weight and muscle mass (ie, resolve obesity or promote regain of lost muscle), reduce postprandial hyperglycemia, and minimize fluctuations in blood glucose. There is strong clinical and research evidence that a diet containing protein as the main ingredient (>40% metabolizable energy [ME], >10 g/100 kcal) and very low concentrations of carbohydrate (eg, carbohydrates <15% ME, <25% dry matter [DM], or <3 g/100 kcal) is most effective in achieving these goals in cats.1-3 In addition, because many feline diabetics have poor muscle condition scores, high-protein diets are essential to replacement of that lost muscle, are needed for prevention of hepatic lipidosis during weight loss, and are essential to increasing metabolism to help promote fat burning and normal insulin function.4-7 The second half of this article reviews the role of diet in treatment of diabetes. To the extent that it exists, evidence from published studies are cited; however, in areas where research evidence is lacking, clinical experience and physiologic principles are used as important sources of guidance.

THE ROLE OF DIET IN REDUCING THE RISK OF DIABETES IN CATS

Diabetes is a complex endocrine disease that results from a convergence of a multiple risk factors, including genetic risk.8 As such, a single factor, such as the diet, is not in and of itself, a causative factor for the disease. However, there are several features of the current most popular feline diets (eg, extruded dry, high-carbohydrate diets, high-energy density) that may increase risk or promote conditions that increase risk, and for that reason it is important to carefully consider diet when examining the situation concerning feline health: feline diabetes is clearly more common that it was 15 years ago when it did not even make the top 25 list of most important feline diseases.9 In the ensuing 15 years, several epidemiologic studies have evaluated the prevalence of diabetes, and examined diet as a risk factor for development of diabetes mellitus in cats. No studies of first opinion practices in the United States have been completed in the past few years, but an estimated prevalence of diabetes at 1.2% of feline patients seen at US veterinary teaching hospitals was reported in 2007.10 Moreover, in all studies, 2 common themes persist: increased age and body weight consistently appear as risk factors for feline diabetes.9-12 Thus, because obesity is one of the
most important risk factors for development of diabetes in cats, it can be stated that improper nutrition plays a critical role in diabetes risk. A large majority of cats (70% by one recent estimate) are either overweight (15%–20% over ideal body weight [BW]) or obese (>20% over ideal BW). Thus, prevention of obesity in young cats and achieving weight loss in obese older cats are key strategic components of dietary therapy aimed at reducing this risk factor for diabetes. There are multiple components to prevention of obesity in cats, but from the perspective of diet, one factor is key: providing excess energy through free choice or ad libitum feeding of neutered, inactive, indoor cats is to be strongly discouraged. In addition to counseling owners about the importance of feeding cats a measured amount of food matched to their energy needs, it is also crucial to advise owners on how to help maintain dietary flexibility in cats. Cats will become habituated to a single food (eg, flavor, texture, odor) if they are fed only one food, and this will create great challenges if a diet change or adjustment is required. Thus, it is important to introduce cats to both canned and dry foods, and continue feeding a mixture of these foods throughout life to help maintain dietary flexibility.

To induce safe, permanent weight loss in cats, a dietary strategy must be embraced that includes the following: (1) feeding a diet high in protein (>40% ME, >45% DM, or >10 g/100 kcal) to prevent loss of muscle mass that can occur with severe energy restriction; (2) feeding a diet that is reduced in energy, and restricted in both fat and carbohydrate, to stimulate fat mobilization (and so that effective energy restriction can be achieved); and, finally, (3) monitoring and adjusting energy intake to achieve effective fat loss. Lean muscle tissue is an essential element of basal metabolism and is necessary for normal insulin function as well. Many weight loss diets are low energy, but not high enough in protein to preserve lean muscle tissue. In studies of cats comparing high-protein or moderate-protein diets during weight loss, cats on high-protein diets had greater success in achieving weight loss, lost fat mass while preserving lean tissue, and had a greater tendency to maintain stable weight after weight loss. A number of diets may be acceptable for preservation of lean muscle tissue, but the goal should be to have fat less than 4 g/100 kcal, carbohydrates less than 3 g/100 kcal, and protein content greater than 10 g/100 kcal. Diets with this profile are easily obtained using canned food diets, and many options exist. In addition, the added water in canned foods increases hydration and food volume, which increases satiety, and both issues are important husbandry concerns in cats. Conversely, extruded dry foods require some carbohydrate in processing for the creation of the shape and texture, and the removal of carbohydrate requires the addition of fat to the diet for processing. Thus, high-protein dry foods are often high fat (and thus high energy), making it very difficult to feed an appropriate amount of the food during weight loss when the need for energy restriction may be extreme. Alternatively, if fat is restricted, the carbohydrate content is typically high, because the manufacturing process limits the amount of protein that can be added to dry food; however, the high carbohydrate content exacerbates postprandial glycemic response, which in some obese cats, results in peak postprandial glucose concentrations in the diabetic range. Addition of fiber may help to attenuate the postprandial glycemic response, but there are no well-designed studies yet in cats that address this.

The other essential aspect of achieving weight loss is to control energy intake. In obese cats, meal feeding will be necessary to meet the specific number of calories required to achieve weight goals. Maintenance energy needs for indoor neutered cats that are of ideal body weight are estimated to be approximately 40 kcal/kg/d (or for the average 4–5-kg cat, an intake of 160–200 kcal/d); however, to achieve weight loss, the energy intake must be restricted much further, with a reduction in energy from this...
maintenance rate by 10% to 40%, or to 20 to 30 kcal/kg, which may mean intakes of 120 to 140 kcal/d for some cats. It is possible to achieve this level of energy restriction and maintain high levels of protein with canned foods. It is very difficult to achieve this level of restriction with a high-protein dry food unless some of the energy has been replaced with fiber. If the cat has been eating free-choice food, the first step is to establish a meal-feeding regimen so that energy intake can be controlled. In a recent comparison between a high-fiber food and a canned food with equal ingredients, cats fed the canned diets begged less and showed more signs of satiety than those on the dry high-fiber diets.20 Thus, because energy intake can be controlled, it is easier to feed a diet with a high-protein/low-carbohydrate nutrient profile. In addition, the added water increases both moisture and volume to the meal; canned foods are a highly desirable option for cats needing to lose weight.

Although there is clear evidence that the incidence of diabetes has increased with the increasing incidence of obesity, it is clearly not a one-to-one ratio, or diabetes would have become a disease of epidemic proportions in recent years. Further, multiple studies show that no single dietary factor is responsible for development of obesity. In fact, the dietary factor most important in development of obesity is diets high in fat, rather than carbohydrate-dense diets (which are sometimes very low in fat).22 Other important risk factors are neutering, overfeeding (particularly free-choice feeding), and indoor/inactive lifestyle.11,17,22 For more information on strategies for obesity management, the reader is urged to consult one of several recent reviews for more information on this topic.18,23

What are the other dietary factors that might play a role in reduction of risk of diabetes in cats? There are a number of ways that the diet composition itself would possibly be important, and of all of the nutrients, dietary carbohydrates have generated the most attention. In a study among feline patients in the United Kingdom, consumption of a mix of wet and dry foods was associated with a lower risk for diabetes, compared with only dry (high-carbohydrate) diets, or only wet (lower-carbohydrate) diets.12 Cats fed wet diets were 3 times more likely to develop diabetes than cats fed mixed diets; cats fed dry diets had 2 times the risk. Slingerland and colleagues24 reported that there was no difference in diabetic risk of healthy cats with consumption of dry or wet foods, but most cat owners fed a mixture of wet and dry foods and the number of cats in the study solely fed dry food was too low to detect a difference if one was present, given the incidence of diabetes in the cat population. Indoor housing and inactivity were associated with an increased risk for diabetes in their study. Thus, in only one epidemiologic study, the type of food (dry vs canned) was a determinant of increased risk for development of diabetes and obesity. Living indoors, physical inactivity, and increasing age were found to be the most important risks for development of diabetes in cats. To better elucidate the contribution of diet to the development of diabetes, well-designed studies are required that have the power to detect differences if they are present.

Recently, there have been a number of published studies comparing the effects of diets differing in dietary carbohydrate, fat, and protein on glucose metabolism in healthy lean and obese cats.7,20,21,25–30 These studies had different points of focus, test protocols, and all were short-term studies in which the level of dietary carbohydrate varied widely: from 0 to 16 g/100 kcal ME (>50% carbohydrate [CHO]). In addition, the level of protein varied inversely to carbohydrate, and ranged from 6.0 to 13.5 g protein/100 kcal ME; thus, the results of these studies were at least partly confounded by alterations in protein concentrations. To date, there is only one study that attempted to address the effect of levels of carbohydrate in the diet on protein intake and use, and in that article, the investigators found that a ceiling effect of high carbohydrate
concentrations on protein intake occurred in cats on diets with a greater than 40% DM carbohydrate. This simply illustrates the difficulty of attempting to study the effects of a single nutrient, because in the body, the interactions of these nutrients are vital and confounding. Finally, the duration of fasting before the initial sample collection and the duration of postprandial collections varied greatly between studies, and, consequently, the results obtained are highly variable, making comparisons difficult, if not inaccurate. For example, it has been documented that it can take 8 or more hours to reach a postprandial peak in blood glucose and 12 to 24 hours for the blood glucose to return to fasting levels in cats fed a single meal. Although there have been 10 studies evaluating carbohydrate effects on blood glucose, only 5 used a 24-hour fast. If only those 5 studies with appropriate 24-hour fasting times are considered, a total of 17 different diets ranging in carbohydrate from 3.2 (<25%) to 14.5 g/100 kcal ME (>50%) were examined. For 5 diets with carbohydrate levels of 6.65 g/kcal or greater, peak postprandial glucose concentrations in many cats, and mean 24-hour glucose concentrations in some cats were above the upper limit of the reference interval established for healthy fasted cats of less than 6.0 to 6.5 mmol/L (108–117 mg/dL). Four of these diets resulted in peak glucose concentrations greater than 8 mmol/L in some cats, which is above the level defined by the International Diabetes Federation as representing postprandial hyperglycemia (7.8 mmol/L) in humans. In one study, when cats fed 12.1 g carbohydrate/100 kcal ME were compared with cats fed diets containing 3.2 (<25% DM) or 8.3 g carbohydrate/100 kcal ME (35% DM), the mean blood glucose was significantly higher, and it remained elevated through the end of the 19-hour period of evaluation. Perhaps the most important finding was that the magnitude and duration of postprandial hyperglycemia observed was exacerbated by weight gain, and in overweight cats, mean postprandial glucose concentration over the entire 24-hour period was between 8 and 9 mmol/L (144–162 mg/dL). Notably, the diet with 14.5 g/100 g/kcal resulted in peak glucose concentrations as high as 10.8 mmol/L (194 mg/dL) in lean cats, and 13.4 mmol/L (241 mg/dL) after moderate weight gain (mean body condition score 6.3), which is considered in the diabetic range for cats. This finding is particularly alarming, considering that in the United States, feline obesity is approaching 70% of all cats presented to veterinarians. Thus, if a large number of these cats have serum blood glucose above what is currently accepted as the glucose reference range for many hours out of the day, what are the long-term implications for beta cell function? Minimizing the increase in glucose concentration following a meal, and the subsequent demand on beta cells to secrete insulin, is a primary goal for management of prediabetic and diabetic human patients, and logically should also apply to feline patients, and especially obese cats. In human studies, it has been shown to be more important (but also more difficult) to normalize postprandial hyperglycemia, as compared with fasting glucose concentrations. Although the International Diabetes Federation defines postprandial hyperglycemia in humans as a plasma glucose concentration higher than 7.8 mmol/L (140 mg/dL), currently, there are no similar recommendations for cats; however, knowing that persistent postprandial hyperglycemia is likely to place a burden on beta cells over months or years, reducing carbohydrate content may be an important step in prevention of diabetes in cats. This is likely most relevant to cats at increased risk of diabetes, such as older cats that are obese, Burmese breed of Australasian or European origin, and/or having repeated corticosteroid administration.

In humans, dogs, and cats, the carbohydrate load of the diet is the primary determinant of postprandial glucose and insulin concentrations. Although protein also stimulates insulin secretion, and protein content is usually increased in
low-carbohydrate diets, in cats, as in other species, it is the carbohydrate content, rather than the protein content, that determines postprandial glucose concentrations. For example, in healthy cats, a high-protein meal (46% ME protein; 26% fat; 27% carbohydrate) and a high-fat meal (26% protein; 47% fat; 26% carbohydrate) gave similar postprandial glucose concentrations, whereas a high-carbohydrate meal (25% protein; 26% fat; 47% carbohydrate) produced approximately 20% to 25% significantly higher postprandial glucose concentrations. Thus, when attempting to lower postprandial glucose concentrations using diet, lowering dietary carbohydrate is the only effective approach.

Although the dietary carbohydrate concentration is a point of focus for its effects on postprandial peak blood glucose and insulin concentrations, perhaps more important in its long-term impact is the duration of the postprandial period that occurs in cats fed high-carbohydrate meals. Previous studies in cats fed diets ranging from 30% to 50% ME carbohydrate, resulted in increases in postprandial glucose and insulin concentrations for an average of 12 to 19 hours in lean cats, with some cats of more than 24 hours, and for at least 18 hours in obese cats. This is in contrast to approximately 6 hours in lean dogs fed a similar meal. The effect of a prolonged elevation of glucose and insulin in the postprandial period over years has not been studied in cats, but in other species, glucose toxicity, hyperamylinemia, and beta cell apoptosis are consequences that may also be predicted in susceptible cats.

In cats allowed continuous access to food, the effect on blood glucose is more complicated because the intake load per meal is often reduced and more variable. One study used constant glucose monitoring and showed that blood glucose in most cats is fairly stable over the course of the day in cats fed a moderate-carbohydrate (6 g/100 kcal ME) diet ad libitum. Another study monitored blood glucose every 3 hours over a 24-hour period in cats fed with either a higher (9.8 g/100 kcal ME) or a lower (2.5 g/100 kcal ME) carbohydrate diet, and showed no difference in total glucose area under the curve. However, there is strong evidence that cats allowed free access to food are more likely to become obese, so the risk for development of glucose intolerance and persistent postprandial hyperglycemia are increased with the development of obesity.

To date, there are no publications reporting controlled, lifelong, or even multiyear studies comparing the long-term effects of high-carbohydrate with low-carbohydrate intake in cats. However, considering that multiple lines of evidence show that cats have a prolonged postprandial increase in blood glucose concentration following ingestion of moderate or high carbohydrate diets, and that this effect may be greatly magnified for both duration and peak concentration in obese cats, there appears to be ample evidence that a return to a higher protein/lower carbohydrate diet more typical of the domestic cat’s ancestors is needed.

THE ROLE OF DIETARY THERAPY IN MANAGEMENT OF DIABETES IN CATS

The goal of treatment of cats with newly diagnosed diabetes mellitus has changed from controlling clinical signs to achieving diabetic remission. Cats in diabetic remission are normoglycemic without the need for insulin. Achieving diabetic remission has substantial benefits for the quality of life of diabetic cats, along with many lifestyle benefits for their owners. Therefore, the treatment protocol selected should aim to maximize the probability of achieving remission. There are several important factors in achieving remission, and they include the following: early institution of a treatment protocol aimed at achieving excellent glycemic control, use of long-acting insulin (glargine or detemir) twice daily, and use of a low-carbohydrate diet. When
good glycemic control is achieved early in newly diagnosed diabetic cats, high remission rates (>80%) are obtained.\textsuperscript{42,44} The interested reader is referred to other sections in this issue or more information on the best approaches to attain this goal.

There are several goals in dietary therapy of feline diabetics, and they include, firstly and most importantly, to use diet to assist in reducing postprandial blood glucose concentrations to facilitate reversal of beta cell toxicity and recovery of insulin secretory capacity. This is particularly important if remission is a goal. A second dietary goal is to reduce fluctuation of blood glucose concentrations after eating and the potential for marked hyperglycemia or clinical hypoglycemia. This is more of a consideration when using long-acting, “peakless” insulin, such as detemir or glargine. Third, to normalize BW, which for many diabetic cats means weight loss, but also can mean regaining muscle mass. To meet or achieve these goals, the diet should be a high-protein (>40% ME, >10 g/100 kcal), low-carbohydrate (<12 ME, <3 g/100 kcal), and moderate-fat to low-fat (if dry) diet, so that energy control can be achieved. If the cat will eat canned/wet food, the energy content is easier to control because of the water in the food.

To increase the probability of diabetic remission in newly diagnosed diabetic cats, the goal of therapy is to achieve blood glucose concentrations as close to the normal range as possible while avoiding life-threatening hypoglycemia.\textsuperscript{42} Achieving normal or near-normal blood glucose concentrations facilitates recovery of beta cells from glucose toxicity. Several studies have shown the benefits of using low-carbohydrate diets in diabetic cats.\textsuperscript{1–3} However, the study by Benett and coworkers was the best designed and compared the glycemic control of a moderate-carbohydrate/high-fiber diet (26% CHO ME) with a low-carbohydrate/low-fiber diet (12% CHO ME) over 16 weeks in newly diagnosed (n = 19) and previously diagnosed (n = 43) diabetic cats.\textsuperscript{2} Sixty-eight percent of cats fed the low-carbohydrate diet achieved diabetic remission compared with the higher carbohydrate group (only 41% achieved remission). At the end of the study, of the cats that still required insulin, 40% on the low-carbohydrate diet were considered well regulated, whereas only 26% on the higher carbohydrate diet were considered to be well regulated and stable. The authors concluded that diabetic cats were significantly more likely to revert to a non-insulin dependent state when fed the canned low carbohydrate food. In the other studies, feeding a low carbohydrate diet to diabetic cats improved diabetic regulation (compared with use of a moderate carbohydrate diet), and lowered the insulin dose and increased diabetic remission by 50%, but both studies lacked adequate controls for comparison to moderate carbohydrate diets.\textsuperscript{1,3}

In addition to the amount of carbohydrate, the type of carbohydrate in the diet also appears to be important. Thus, for cats that will consume only dry-food diets and will have some carbohydrate in their food, the source of carbohydrate should be a complex carbohydrate with a low glycemic index (eg, whole grains such as barley). In a limited number of studies, postprandial glucose and insulin response after consumption of diets with different carbohydrate sources have been compared in healthy cats. Rice, barley, corn, and wheat had relatively higher responses than sorghum, lentil, and cassava flour (tapioca).\textsuperscript{25,33,45,46} To date, most studies comparing differing levels of carbohydrate in diabetic and healthy cats have used diets with carbohydrate sources, such as corn, soy, sorghum, and wheat: all grains that result in a significant postprandial increase in glucose and insulin concentrations. Novel carbohydrate sources, such as lentil and cassava flour, were associated with no postprandial increase in glucose and minimal insulin responses after being fed as a single meal of approximately 68 kcal/kg.\textsuperscript{25} Currently, a postprandial glycemia index has not been developed in veterinary medicine equivalent to the glycemic index in human
medicine, so a comparison of the glucose response of a meal with a particular grain to that of a very highly digestible/high glycemic index carbohydrate (such as white bread) is not validated. Total carbohydrate load includes both the carbohydrate content and the glycemic response of that carbohydrate source, and is believed to be more important than just the carbohydrate content alone. Commercial diets with novel carbohydrate sources have been developed for cats, but currently there are no data on their effect on glycemic response.

Cats in diabetic remission continue to have impaired glucose tolerance and some have impaired fasting glucose concentrations despite having normal blood glucose levels, and thus, should be considered prediabetic and at risk of redeveloping overt diabetes. In 3 recent studies, at least 25% of cats in diabetic remission reverted to overt diabetes and again required exogenous insulin to control their clinical signs. Thus, cats in diabetic remission will continue to benefit from feeding of a low-carbohydrate/high-protein diet indefinitely.

Although it is important to implement a low-carbohydrate diet in the management of cats with diabetes as soon as possible, there are circumstances where this should be delayed or may be inappropriate. In sick, inappetant diabetic cats, the first priority is to offer food the cat will eat. Because of the risk of food aversion developing in cats, dietary changes should be implemented when the cat is eating readily and made slowly over 7 to 10 days, gradually replacing the original diet. In long-term diabetic cats (diagnosed >2–3 years previously), or those with concurrent disease, such as untreated acromegaly or irreversible end-stage pancreatitis, in which the probability of remission is low, in these cats, the goal of therapy should be to control clinical signs by minimizing hyperglycemia, avoid life-threatening hypoglycemia, and use appropriate dietary management of other health issues as indicated. For example, in cats with stage 3 chronic kidney disease requiring phosphorus restriction and a reduction in dietary protein, high-protein/low-carbohydrate diabetic diets may not be appropriate. In cats with earlier stages of chronic kidney disease, phosphorus should be restricted, if possible using other methods than changing to a protein-restricted diet (higher in carbohydrate), because this will likely reduce the probability of remission, and chronic hyperglycemia likely has adverse effects on the kidney, as it does in other species. Of note, grocery-line diets with very low carbohydrate are often predominantly fish or meat, and have substantially higher phosphate levels than the some of the veterinary prescription diets designed for diabetes.

Finally, although cats prefer to eat small, frequent meals (nibble or graze), it is helpful if diabetic cats are fed a measured amount of food at the time of the insulin injection so the owner can observe if the cat is eating appropriately at least twice daily. At this stage, there are no published data on the effect of once-daily, twice-daily, or multiple meals on postprandial glucose concentrations in cats to make firm recommendations on the best feeding pattern for diabetic cats. If the cat is prone to hypoglycemia or prefers small frequent meals, it is completely reasonable to divide the daily energy requirement into 4 separate feedings. This can be easily achieved by using timed feeders, so the cat has the opportunity to eat multiple times per day while controlling intake, but at the same time providing an energy source mid-day should the cat need or prefer it.

**SUMMARY**

To maximize the probability of remission, a low-carbohydrate diet should be introduced soon after diagnosis of diabetes when the cat is eating well. Low-carbohydrate diets should be continued after remission to minimize postprandial
glycemia, and the demand on beta cells to secrete insulin. For cats already on insulin therapy, when changing from a high-carbohydrate to a low-carbohydrate diet, the insulin dose initially should be reduced by 30% to 50% to avoid hypoglycemia. Combined with high protein to facilitate weight loss and maintenance of muscle mass, low-carbohydrate diets should be used in obese cats that have the potential to achieve remission. Diabetic cats with advanced chronic kidney disease resulting in inappetance will need a protein-restricted diet (therefore, higher carbohydrate). In earlier stages of renal disease, to maximize the probability of remission, phosphorus should be managed using methods other than restricting protein. Cats should be fed the diet that is most appropriate for any medical problem requiring dietary intervention if they have a very low probability of remission; that is, cats diabetic for longer than 2 years despite excellent glycemic control, and cats with untreated concurrent disease causing loss of beta cells (pancreatic neoplasia, or advanced chronic pancreatitis evidenced by concurrent loss of exocrine function). Nonetheless, a low-carbohydrate/high-protein diet is likely to lead to lower postprandial glucose concentrations, and thus should be used unless there is a medical need to change diets. Because diabetic remission is an important goal, frequent monitoring (both of body weight and glycemic control) and access to controlled amounts of low-carbohydrate/high-protein food is the best strategy.

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